Management Models Evaluation of a *Castanea sativa* Coppice in the Northeast of Portugal

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INTRODUCTION

The coppice is a very flexible system, producing wood with small, medium or large dimensions. At the present, logs with small dimension don't have the recent past demand. Thus, it's necessary to improve the management of the existent coppice stands through the application of appropriate silvicultural models. In this trial we adapted the models proposed by Bourgeois (1992). With the application of these models we intended to produce wood material of the three referred dimensions and to quantify the growth, trying to demonstrate the economical advantage of the larger dimensions model. In spite of that, the choice of the production objective must result from a compromise between the suitable technical (attaining site conditions) and the best economical options.

MATERIALS AND METHODS

In 1994, through the project MEDCOP, financed by the European Union, 4 permanent research plots with about 1000 m2 were established in a *Castanea sativa* Mill. coppice. This stand was converted from a high forest with 50 years old.
The following treatments were applied: T 1 - Plot 1 = Model 1 (Small dimensions); T2 – Plot 2 = Model 2 (Medium dimensions); T3 – Plot 4 = Model 3 (Large dimensions); Control – Plot 3 = (without intervention).
The plots were submitted to a 1st thinning in 1999 (with 7 years old), and to a 2nd thinning in 2003 (with 11 years old) selecting, according to qualitative criteria, the more straight and cylindrical shoots without defects, aiming to apply different wood dimensions production management models presented in the table 1. The first dendrometrical measurement of the shoots was carried out at the age of 3 years, the second at the age of 7 years and the third at the age of 11 years. The following variables were evaluated:
Number of stumps per hectare (N_{st}); number of shoots per hectare (N_{sh}); mean total height of the shoots (hg); dominant height of the shoots (Hdom); mean diameter of the shoots (dg); dominant diameter of the shoots (Ddom); basal area of the shoots per hectare (G); basal area of the shoots (g_{sh}).

Table 1. Different silvicultural models applied.

	Cultural Operations	Height of dominant shoot in stool (m)	Age (years)	Shoots per hectare before thinning	Shoots per hectare after thinning	Rotation age (years)
Model 1 Small dimensions	1 Thinning	6-9	5-9	9000-15000	3000-3500	25-30
	2 Thinning	10-12	10-14	3000	1500	
Model 2 Medium dimensions	1 Thinning	6-9	7-9	9000-13000	2000-2500	30-35
	2 Thinning	11-12	11-13	2000-2500	600-800	
		Height (m)	Age (years)	Cultural Operations		
Model 3 Large dimensions		10-12	10-13	Selection of 150 to 250 future shoots /ha		40-50

RESULTS AND DISCUSSION

Data collected were analyzed and are presented in the Tables 2, 3 and 4 as well as in Figures 1, 2 and 3. Figure 4 shows the removed basal area in the 2nd thinning.

Table 2. Results of the second dendrometrical measurement after thinning.

7 years after thinning									
	N_{st}/ha	N_{sh}/ha at start	N_{sh}/ha	hg (m)	Hdom (m)	G (m^2/ha)	g_{sh} (m^2)	dg (cm)	Ddom (cm)
Plot **1**	636	8868	3473	7.0	7.9	11.6	0.0033	6.5	11.3
Plot **2**	654	8491	3778	7.5	9.1	13.7	0.0036	6.8	11.9
Plot **3**	617	8613 *	6305*	6.8	8.1	14.6	0.0023	5.4	11.6
Plot **4**	574	8745	2523	8.4	10.7	10.1	0.0040	7.1	12.5

Table 3. Results of the third dendrometrical measurement before thinning.

11 years after thinning							
	N_{sh}/ha	hg (m)	Hdom (m)	G (m^2/ha)	g_{sh} (m^2)	dg (cm)	Ddom (cm)
Plot **1**	1501	9.6	11.2	12.6	0.0084	10.3	14.9
Plot **2**	761	10.3	11.1	6.2	0.0082	10.2	13.8
Plot **3**	5788 *	8.9	11.4	24.7	0.0043	7.4	15.6
Plot **4**	534	10.3	11.7	4.3	0.0081	10.1	13.3

Table 4. Results of the third dendrometrical measurement after thinning.

11 years before thinning							
	N_{sh}/ha	hg (m)	Hdom (m)	G (m^2/ha)	g_{sh} (m^2)	dg (cm)	Ddom (cm)
Plot **1**	3422	8.9	11.6	22.7	0.0066	9.2	15.5
Plot **2**	3685	9.9	10.2	24.5	0.0066	9.2	15.9
Plot **3**	5788	8.9	11.4	24.7	0.0043	7.4	15.6
Plot **4**	2510	9.8	12.8	17.4	0.0069	9.4	15.9

*** - Reduction in the number of shoots per hectare (N_{sh}) in plot 3 is only due to natural mortality.**

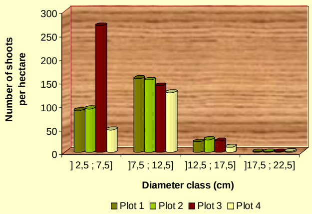

Fig. 1. Diameter distribution of the number of shoots at the 11th year before thinning.

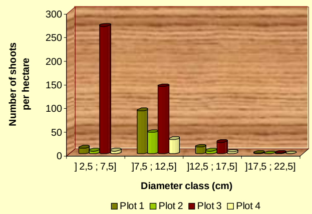

Fig. 2. Diameter distribution of the number of shoots at the 11th year after thinning.

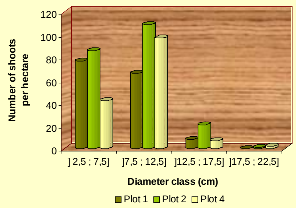

Fig. 3. Diameter distribution of the number of shoots removed at the 11th year thinning.

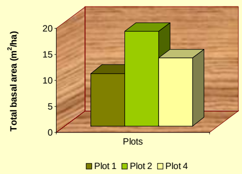

Fig. 4. Basal area removed at the 11th year before thinning.

With the first intervention (year 1999), the number of shoots left, was superior to that proposed by Bourgeois (1992) because the coefficient of stability (h/d), do not allowed a more intense thinning, especially in the plots P2 and P4. However, in the last intervention (year 2003), it was possible to reduce the number of shoots to densities proposed in Table 1. Plot 4 still presents greater vigor than the other plots, showing higher dominant height (Hdom).
Plot 2 was exceed by plot 1 in relation to Hdom, probably because last one has more shoots, which results in higher competition levels for natural resources. We believe that by the heavy thinning applied in plot 2, reducing the number of shoots from 3685 to 761, we expect that this plot (T2) will again recover its dominant height leadership in relation to plot 1 (T1).
The plot 3 (control), at this moment, follows the other plots dominant height growth pattern, although presents a particularly inferior mean basal area shoot in comparison to the other treatments.
Note that values for dominant height and also for the quadratic mean diameter and dominant diameter can decrease after a thinning because by the selection applied, some of the thickest and higher shoots can be removed if have not a straight and cylindrical form or present defects. With this procedure we are, on the one hand, selecting for the final cut, shoots that presents well formed boles and on the other hand to make available logs with commercial dimensions easily saleable.

FINAL CONSIDERATIONS

With the monitoring of the trial and successive data analysis, we expect that if suitable management models are applied, there is opportunity to select shoots with quality and dimensions that give an answer to market demand, conducing to greater revenues for forest producers.

ACKNOWLEDGMENTS
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